# Marine Shoreline Armoring in Puget Sound and the Washington State Hydraulic Code

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## Introduction

The shoreline of Puget Sound is approximately 2500 miles long (PSAT 2005) and contains an abundance of marine habitats that support a diverse assemblage of fish, shellfish, birds, marine mammals and other wildlife. In addition, the shores of Puget Sound support an array of human recreational activities, waterborne commercial activities (Port facilities, Ferry terminals, marinas, etc.), and are a prized location for single-family residences due to spectacular views, beach access and general beach ambiance. As such, population increases in Washington State have been coupled with accelerated human development activities on Puget Sound shorelines. Most notably, single-family residential development along Puget Sound shorelines appears more popular than ever.

Historically, many early residences along the shores were constructed for seasonal use and were relatively small structures. More recently, new shoreline residences are rather spacious and occupied year-round. In addition, many older structures have been significantly enlarged and reconstructed for year round habitation. Moreover, many lots that were formerly vacant due to difficult terrain and landslide hazard are now being utilized for residential construction as waterfront properties become increasingly expensive. Shoreline armoring, in the form of bulkhead construction, is often considered essential to protect these real estate investments from erosion. For all saltwater shorelines of the state it has been estimated that approximately half of the shoreline modifications are associated with single-family residences (Berry and Kazakov 2004). Such shoreline modifications have been extensive, particularly in central Puget Sound, and have been shown to result in changes to habitat forming processes important to fish and wildlife (Williams and Thom 2001).

Puget Sound beaches are primarily composed of sediment eroded from local bluffs (Downing 1983) and bulkhead construction that impounds sediment and prevents erosion can therefore significantly affect beach composition and structure (Canning and Shipman 1995). For example, wave energy reflected from bulkheads causes an increase in turbulence and erosional energy waterward of the structure that can result in substrate coarsening and lowering of the beach profile (McDonald et al. 1994). Alterations of shoreline physical conditions like these can significantly affect habitat structure and function. In the extreme, bulkheads and associated fill cover spawning habitats formerly used by forage fish that spawn in the upper intertidal zone (e.g., surf smelt (*Hypomesus pretiosus*) and Pacific sandlance (*Ammodytes hexapterus*). In addition, impoundment of sediments that provide a source of appropriately sized substrate can significantly impact forage fish spawning both adjacent to the bulkhead and for some distance down drift due to loss of fine-grained sediments. Loss of shoreline vegetation commonly associated with bulkhead construction also adversely impacts shoreline function. In addition to providing shade, protective cover, and stabilizing shoreline erosion, marine shoreline vegetation is also particularly valuable for providing insect prey important to juvenile salmon (Levings et al. 1991, Brennan et al. 2004). These are but a few of the adverse impacts resulting from bulkhead construction; for a more complete review see Williams and Thom (2001).

Trends in the construction of bulkheads on Puget Sound shorelines are not well documented although substantial increases in armoring are obvious to those who spend much time on Puget Sound beaches. Thurston County, in southern Puget Sound, conducted an analysis of the rate of bulkhead construction within the County's approximately 110 miles of shoreline (Morrison 2001). They estimated that in 1972 there were approximately 28.0 miles of armored shoreline, representing 27% of the total shoreline. By 1999, this armoring had increased to 37.8 miles, representing 9.8 miles of new armoring. In addition, between 1985 and 1999 repairs to existing bulkheads occurred along 17.6 miles of shoreline within the County. Overall, it was estimated that 36.6 % of the Thurston County shoreline was armored by 1999.

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Due to concerns for adverse impacts to shoreline resources from shoreline armoring, both state and federal regulations have been implemented to address the potential impacts of bulkheads. The Washington Department of Fish and Wildlife (WDFW), in particular, developed regulations aimed at protecting fish and their habitats from adverse impacts of shoreline development activities. These regulations are referred to as the Hydraulic Code. Statutory language of the Hydraulic Code, enacted by the Washington State Legislature, is found in the Revised Code of Washington (RCW) under section 77.55; the implementing language, developed by WDFW, is located in the Washington Administrative Code (WAC) under Chapter 220-110. Our intent in this report is to present the historical trail of these RCWs, WACs, and associated background that led to the current set of laws utilized by WDFW in regulating the design and construction of bulkheads on the shores of Puget Sound. Understanding the history of the development and implementation of the regulations is the first step toward understanding the effectiveness of habitat protection regulations for fish resources.

## Methods

To develop this chronology of the Hydraulic Code we initially interviewed a number of WDFW employees who previously worked in the Habitat Program and reviewed Hydraulic Project Applications. In addition, we searched records at the Washington Attorney Generals Library and the State of Washington Law Library for the original records of the Revised Code of Washington and the Washington Administrative Code related to the Hydraulic Code. We also interviewed bulkhead contractors who were active before the Code was actively implemented in marine waters. Finally, the authors have had extensive experience reviewing applications and issuing HPAs.

## Results and Discussion

The Hydraulic Code is one of the oldest environmental laws in Washington State. The State Legislature enacted the law in 1949 (RCW 75.04.16), requiring anyone constructing "any form of hydraulic or other project that will use, divert, obstruct or change the natural flow or bed of any river or stream or that will utilize any waters of the state or materials from stream beds" to secure written approval from the directors of Departments of Fisheries and Game before commencing work. In addition to submitting plans for the project to both Departments, applicants were also required to submit plans "for protection of fish life". The original law was shorter and more simplistic than later versions and many jurisdictional questions were unclear.

> *RCW 75.04.16 (1949) In the event that any person or government agency desires to construct any form of hydraulic or other project that will use, divert, obstruct, or change the natural flow or bed of any river or stream or that will utilize any of the waters of the state or materials from stream beds, such person or government agency shall submit to the department of fisheries and the department of game full plans and specifications for the proper protection of fish life in connection therewith and the approximate date when construction or work is to commence, and shall secure the written approval of the director of fisheries and the director of game as to the adequacy of the means outlined for the protection of fish life in connection therewith and as to the propriety of the proposed construction or work and time thereof in relation to fish life, before commencing construction or work thereon. If any person or government agency commences construction on any such project without first providing plans and specifications for the proper protection of fish life in connection therewith and without first having obtained written approval of the director of fisheries and the director of game as to the adequacy of such plans and specifications submitted for the protection of fish life, he, it or they shall be guilty of a gross misdemeanor. If any such person or government agency is convicted of violating any of the provisions of this section and continues construction on any such project without fully complying with the provisions hereof, such project is a public nuisance and shall be subject to abatement as such.*

The Hydraulic Code was recodified and revised in 1955 as RCW 75.20.100 adding verbal approvals for emergency conditions. It was revised again in 1967 to clarify that failure "to follow or carry out any of the requirements or conditions as are made part of such an approval" constituted of violation of the law.

Although fish habitat protection law was in place in 1949, the Departments of Fisheries and Game did not implement the Hydraulic Code in saltwater habitat for nearly 30 years. The term "utilize any of the waters of the state" was sufficiently fuzzy to hinder application to saltwater habitats. In addition, nearshore and marine waters were considered important habitat for herring, shellfish and marine fish species, but were not associated with early salmon management. Salmon researchers initially thought that numbers of returning adult salmon were a function of conditions occurring in freshwater and that marine waters were limitless for salmon production (Hatchery Scientific Review Group, 2004). Therefore, early fish habitat protection and enhancement efforts focused on freshwater habitats.

The Department of Fisheries regulated "classified food fish" (e.g. salmon, surf smelt), while the Department of Game regulated "game fish" (e.g. steelhead). "Non-classified" species included many marine fish and invertebrates not considered of sufficient commercial or recreational importance by the State Legislature to warrant classification (e.g. barnacles). While these marine species were managed by the Department of Game, they received little attention for habitat protection. Wildlife species were not included at all in habitat protection under the Hydraulic Code as the law specifically pertains to "protection of fish life".

From early settler history through the early 1970's, shoreline landowners were able to create residential building lots from tidelands and shoreline developments without much regulatory oversight. Puget Sound tidelands were sold to private individuals shortly after Washington became a state to promote oyster and shellfish industry. The practice of selling public tidelands stopped in 1970, leaving approximately 60% of Puget Sound tidelands in private ownership (Cheney and Mumford, 1986). Early shoreline development was concentrated in small waterfront communities dependent on water transportation. With the advent of highways and automobile travel, shoreline residences became more practical to build along the entire shoreline. Many counties retain high population densities and small lots along the outline of the marine shorelines (e.g. Kitsap, Thurston), relics of land use development patterns of the past. Canal communities (e.g. Driftwood Keys, Bridgehaven in Hood Canal) were developed in the 1960's by dredging and filling to create high density residential marina communities. Landfill was often used to create buildable lots along roads when waterfront land was limited. Contractor Jim Jesfield indicated that prior to the 1970's and the enactment of the Shoreline Management Act, landfill used in shoreline armoring along lower Hood Canal was limited by financial and practical considerations (site access, covering oysters) rather than environmental restrictions (Jesfield, pers. comm.). Landfill and armoring projects along Puget Sound residential shorelines resulted in incremental loss of upper beach and estuarine habitat along long stretches of shoreline. Federal, state and local regulatory oversight was essentially absent during this time period.

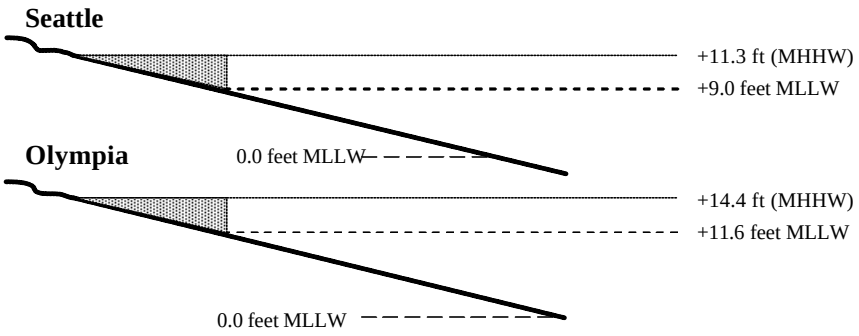
**1971: WDF adopts guidelines for bulkhead construction**

Observations of juvenile pink (*Oncorhynchus gorbuscha*) and chum (*Oncorhynchus keta*) salmon migration along shallow shorelines by Washington Department of Fisheries (WDF) staff biologists (Heiser and Finn 1970), along with concerns for shellfish habitat, convinced WDF to more aggressively pursue protection of food fish habitat in saltwater in the regulatory arena. Criteria were adopted by WDF as a "policy guideline" in 1971for bulkheads, landfills and marinas (Washington Department of Fisheries, 1971).

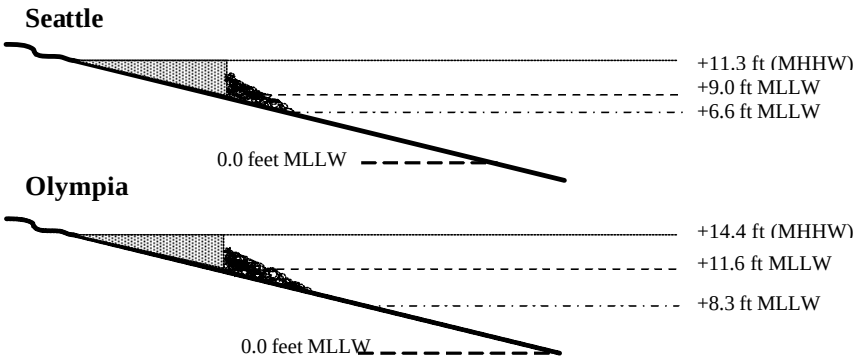
Early bulkhead criteria are nearly unrecognizable by today's standards. Heiser and Finn (1970) provided some of the earliest direct observations of juvenile salmon and migration along saltwater bulkheads and marinas. They hypothesized that bulkheads sloped at 45 degrees or less (e.g. railroad revetments) provided protective habitat for young salmon due to irregularities not found in vertical bulkheads. Therefore, criteria for sloping and vertical bulkheads were provided, with encroachment of the toe of sloping bulkheads extending to half the mean tide level (Figure 1). This tide level was thought to provide adequate habitat protection for shellfish resources and food items important to migrating salmon. Heiser and Finn (1970) noted that salmon fry were reluctant to migrate along vertical bulkheads in deep water. They evaluated spring tides to determine tidal elevations that would have one foot of water at high tide for less than 10% of the time and used this criteria to determine the toe of vertical bulkheads. Sloping and vertical bulkhead criteria adopted in 1971 are shown in Figure 1.

In addition, the 1971 WDF criteria included a provision that sloping or vertical bulkheads "shall in no instance extend seaward more than 100 feet from MHHW [mean higher high water], except where the natural beach slope is less than 5% which will be reviewed individually". The guidance criteria applied to both new structures and repairs, and allowed provisions to address timing and construction impact concerns. The guidance also allowed revision as more biological information became available.

However, the policy guidance was not applied to permits written by WDF. The foreword of the 1971 guidelines states that the criteria would be used by WDF to "supplement whatever requirements are specified by other




1971 bulkhead criteria for vertical bulkhead construction.




1971 bulkhead criteria for sloping bulkhead construction.

| | | Minimum Tide Level | |
|---|---|---|---|
| | Tidal Reference Area | Vertical Bulkhead | Sloping Bulkhead |
| 1 | Shelton | +11.5’ | +8.0’ |
| 2 | Olympia | +11.6’ | +8.3’ |
| 3 | South Puget Sound | +10.7’ | +7.7’ |
| 4 | Tacoma | +9.4’ | +6.9’ |
| 5 | Seattle | +9.0’ | +6.6’ |
| 6 | Edmonds | +8.9’ | +6.6’ |
| 7 | Everett | +8.8’ | +6.5’ |
| 8 | Yokeko Point | +8.7’ | +6.5’ |
| 9 | Blaine | +7.5’ | +6.1’ |
| 10 | Port Townsend | +6.5’ | +5.1’ |
| 11 | Union, Hood Canal | +9.4’ | +6.9’ |
| 12 | Seabeck, Hood Canal | +9.2’ | +6.8’ |
| 13 | Bangor, Hood Canal | +8.7’ | +6.5’ |

Figure 1: Summary of Tables 1 and 2, and Figures 1 and 2 from 1971 Washington State Department of Fisheries guidance document entitled “Criteria governing the design of bulkheads in Puget Sound, Hood Canal, and Strait of Juan de Fuca for protection of fish and shellfish resources”. Tidal Reference Areas are included in the map of Figure 2.

local, state and federal agencies in their review of these applications." The criteria were to be "strictly adhered to" and would be contained in "any written approval by the State of Washington". Nonetheless, WDF continued to condition permits written by other agencies and did not implement the Hydraulic Code in saltwater.

Also in 1971, Washington State Legislature adopted the Shoreline Management Act (SMA) and the voters affirmed the SMA by referendum in 1972. The legislation followed the 1969 Washington State Supreme Court decision in the case of Wilbour vs. Gallagher (77 Wn 2d 302), commonly known as the Lake Chelan Case, that "certain activities along shorelines were contrary to the public interest." Local jurisdictions, many of which had only relatively recently adopted zoning laws and required building permits, administered shoreline permits using the state version of the Shoreline Master Plan until local plans were adopted around the mid-70's. While the adoption of the SMA appeared to dramatically decrease the large landfills and building lot creation along tidelands, there had already been substantial alterations to Puget Sound's marine shorelines.

Under the SMA, residential construction activities including bulkheads, docks and piers were considered "normal, protective and common appurtenances for single family residences" (Broadhurst 1998). Single-family residence (SFR) bulkhead construction and repair were exempt from obtaining a shoreline permit, subject to the conditions of the shoreline plan (RCW 90.58). However, shoreline modification associated with single-family residences accounts for over half of all shoreline modification in Washington State (Berry and Kazakov, 2004).

Typical bulkhead criteria in early shoreline master plans included provisions as follows (excerpts from the 1977 Pierce County Shoreline Master Plan, Chapter 65.28.030):

> *B.2. The construction of a bulkhead on shorelines where no bulkheads are adjacent shall be within five feet from the foot of the natural bank or landfill…If no distinct bank exists, construction shall be landward of the mean higher high water mark.*
>
> *B.3. Bulkheads may tie in flush with existing bulkheads on adjoining properties, except where said adjoining bulkheads extend more than 20 feet beyond the foot of the natural bank or landfill…to the extent feasible, should be contoured within five feet of the foot of the natural bank or permitted landfill. Multiple bulkheads proposed by two or more adjoining property owners to tie in together may tie in flush with existing bulkheads…"*
>
> *A.4. A person who has received approval in keeping with these regulations to construct a bulkhead, shall grant adjacent property owners the privilege to tie in and meet with a bulkhead when they have an approved permit.*

In practice, the local jurisdictions often deferred to the criteria of the Department of Fisheries and allowed bulkhead construction waterward of the stated SMP criteria.

Implementation of the Rivers and Harbors Act of 1899, Section 10, by the US Army Corps of Engineers was typically limited to marine construction such as dredging, and marine commerce activities affecting navigation. Jurisdiction was limited to "navigational waters of the US", interpreted as below mean high water tide line. In 1972, Section 404 of the Clean Water Act (formerly Federal Water Pollution Control Act) added regulation by the Corps of the "discharge of dredged or fill material into the waters of the US". While the jurisdiction of Corps review for Section 404 permits extended landward to mean higher high water line, the Corps adopted nationwide permits (NWP), including NWP 13 which did not require an individual Section 404 permit for bank stabilization under 500 feet in length or less than 1 cubic yard per running foot. Repairs were allowed as maintenance activities under NWP 3. As such, federal review of marine construction was typically limited to large-scale projects below mean high water. Residential bulkhead construction rarely needed to obtain an individual Corps permit.

**1974: Surf smelt habitat moves to the forefront**

In 1972, WDF biologist Dan Penttila began investigating surf smelt life history and habitat as part of the Puget Sound Baitfish Project. The Baitfish Project, studying primarily Pacific herring (*Clupea pallasi*) and surf smelt, was an element of the 1971 WDF Puget Sound Recreational Fishery Enhancement initiative (WDFW 1998). Surf smelt, along with herring, "candlefish" (Pacific sandlance) and Northern anchovy (*Engraulis mordax*) were

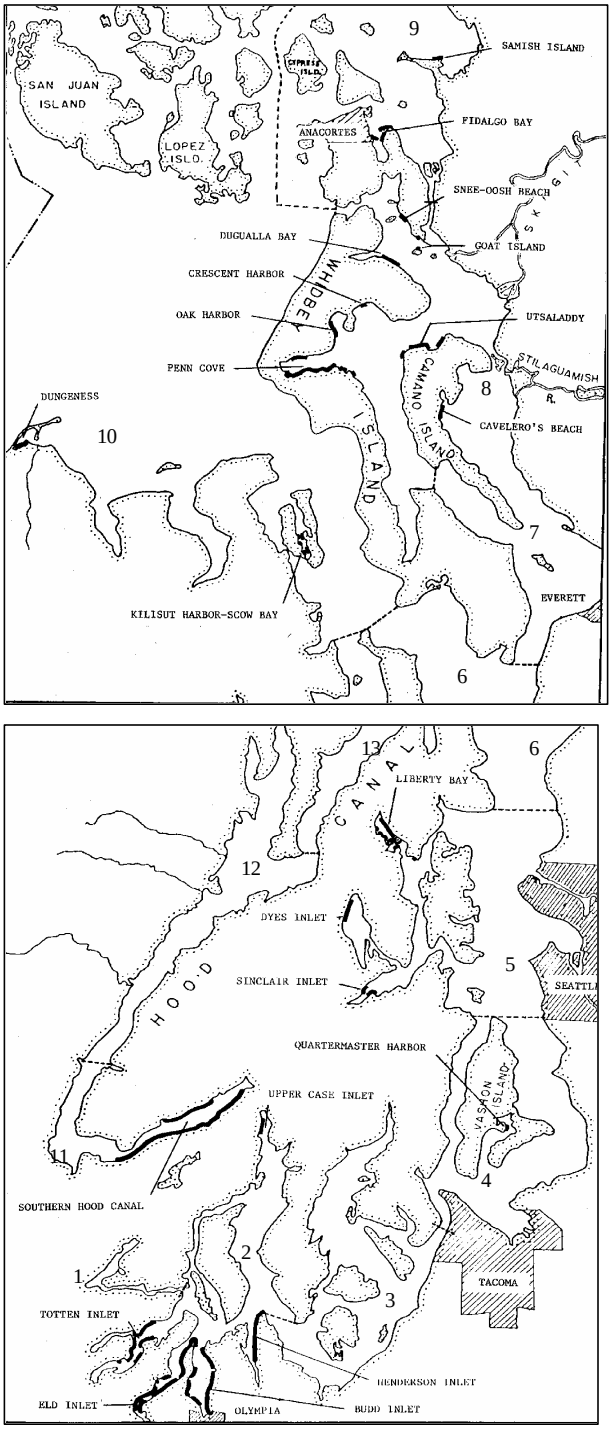



Figure 2: Known distribution of surfsmelt in 1974 when Washington Department of Fisheries adopted bulkhead criteria to protect surfsmelt (WDF, 1974). Documented spawning grounds in 1974 included approximately 60 miles. Further studies of Puget Sound beaches extend the known spawning distribution of forage fish to approximately 250 miles (Penttila, pers. comm.). Tidal reference areas listed in Figure 1 are shown.

recognized as important forage fish for commercially and recreationally important fish species. In addition, surf smelt support a small commercial and recreational fishery at traditional sites in Puget Sound (WDFW 1998).

Surf smelt are common nearshore residents, spawning at high tides on mixed sand-gravel substrates in the upper intertidal beach (Penttila 1978). When the Baitfish Project began, approximately 40 miles of Puget Sound shorelines were known to support surf smelt spawning. The surveys quickly revealed that marine construction projects were impacting surf smelt spawning grounds and that the 1971 criteria were not protective of this fish habitat. WDF forage fish biologists were regularly accompanying habitat staff to provide technical assistance for bulkhead construction projects (Penttila, pers. comm.). Clearly, modifications of the 1971 WDF bulkhead criteria were in order.

In March 1974, WDF adopted supplementary guidelines to the 1971 bulkhead criteria for "those beaches used by surf smelt for spawning". Criteria for bulkhead tidal elevations were generally at or near mean higher high water for sites with documented surf smelt spawning. However, at the time of adoption, less than 60 miles of Puget Sound beaches were documented (Figure 2), compared with nearly 250 miles currently known to support surf smelt spawning (Penttila, pers. comm.). Although a progressive step to protect forage fish habitat, the supplementary criteria included a provision that "the above criteria will still allow for the use of pilings and platforms to create additional "dry-land" space."

The 1974 guidelines also allowed beach inspection before acting on a permit. The surf smelt inspection became an important element of residential bulkhead construction. Field biologists commonly would delay a response for sites with appropriate grain size for up to nine months to allow several surf smelt inspections during a spawning season (Mary Lou Mills, pers. comm.). The legislature later shortened review time by amending the Hydraulic Code to add a 45-day time limit for HPA permit issuance in 1983.

Despite increased concern for marine habitat protection, WDF was still uncertain regarding the application of the Hydraulic Code to marine waters and did not implement direct permit authority. The 1974 supplementary criteria included the following statement: "In the event of any future unauthorized bulkheading or filling on smelt spawning beaches, the Department of Fisheries will take appropriate steps in requesting the Corps of Engineers to have such unauthorized construction removed." We also note that the division of WDF implementing the Hydraulic Code in 1974 was still titled the "Stream Improvement Division".

**1977: WDF extends Hydraulic Code authority to marine waters**

By the mid-70s, the emerging science on the importance of marine shorelines to early life history of salmon and the need for protection of shellfish and forage fish habitat led to repeated attempts to require WDF hydraulic approvals for marine construction projects. Marinas were of particular concern (e.g., Cardwell et al. 1980) and in January 1977, the Pollution Control Hearings Board ruled that WDF & Washington Department of Game did not exceed their authority in granting a hydraulics permit for the East Bay marina in Olympia (PCHB No. 1032, pg. 25).

In March of 1977, WDF took the position that RCW 75.20.100, the Hydraulic Code, applies to marine waters and began to write hydraulic project approvals (HPAs) for marine projects. However, the department was reluctant to test this application in court and relied on negotiation rather than enforcement in many cases to protect habitat.

Although impacts to surf smelt, migrating juvenile salmon and shellfish habitat were receiving attention from WDF marine habitat staff in the 70's, estuaries and marshes were not. WDF marine biologist Mary Lou Mills recalls that the paradigms of the time were that salmon did not use marshes and that major river mouths were polluted such that design of projects should aim to make the habitat undesirable so that juveniles would leave sooner (Mills, pers. comm.). While estuaries on the East coast of the U.S. were known for high productivity and contributions to the early life history of commercially important fish and shellfish, marshes and estuaries of the West coast received less attention. Fish managers at the time thought that marine salmon production was influenced primarily by nutrients of the Pacific Ocean and was not tied to estuarine habitat. However, new studies indicated the importance of estuarine residence for salmon for survival, that the diet of juvenile salmon often included dipterans found in marshes, and that coho rear in estuaries. By the early 80's, WDF marine

habitat staff were protecting estuarine habitat for locations where juvenile salmon use was documented (Mills, pers. comm.).

**1983: WDF adopts WACs and Hydraulic Code changes to include saltwater**

The Departments of Fisheries and Game began drafting the Hydraulic Code rules and procedures for formal adoption in 1978. In 1983, the formal process was complete and Chapter 220-110 WAC, along with WAC 232-14-010, was adopted. The WACs contain detailed descriptions of surf smelt and Pacific herring spawning areas and timing to avoid construction impacts ("work windows") for forage fish. Common technical provisions for bulkheads also included minimum tidal elevations for vertical and sloping bulkhead designs from the 1971/74 criteria, and construction timing to avoid the peak outmigration of juvenile pink and chum salmon (March 15 to June 15 in most areas).

Also in 1983, the Hydraulic Code (RCW 75.20.100) was revised to specifically include saltwater projects. Three marine habitat biologists processed HPAs for the entire state, with both of the Puget Sound biologists each writing approximately 600 permits per year. As such, bulkhead permits were only field reviewed when surf smelt habitat was suspected and compliance for bulkhead alignment was rarely field checked.

As a result, new bulkheads commonly extended 10–15 feet waterward of ordinary high water line (OHWL), but are restricted to approximate MHHW in "documented" surf smelt spawning areas. Bulkhead repairs commonly resulted in construction of a new bulkhead waterward of existing structure or, in some cases, waterward of a previous repair. Sloping bulkheads were falling out of favor, due to concern for surf smelt habitat and studies indicating that rip rap is good habitat for predators and poor habitat for invertebrate food organisms for juvenile salmon (Mills, pers. comm.). Cardwell and Koons (1981) studied the biological impacts of marine structures, stating that "Habitats of certain trophically important invertebrate species may be inundated when bulkheads, particularly sloping ones, are constructed according to the minimum tidal elevations prescribed by WDF…. In general, however, constructing bulkheads above certain minimum tidal heights should protect the majority of food fish prey."

Also in the 1980's, shoreline natural processes entered the dialogue of shoreline planners and biologists as recognition of indirect impacts of shoreline alterations increases. Cardwell and Koons (1981) note that "some types of bulkheads may alter patterns of geohydraulic energy on beaches and lead to erosion of the foreshore…It is not known whether the tidal height minima for bulkheads are sufficient to prevent subtle changes in the particle size composition of the foreshore." In addition, bulkhead construction proposals along shorelines with poor land management practices (e.g. bluff, drainage problems) were common but difficult projects.

In the early 1980's, fish eggs other than surf smelt are also encountered in baitfish surveys of upper intertidal habitat. In 1989, these eggs are identified as Pacific sandlance, another important forage fish (Penttila, 1995). Identification and protection of sandlance spawning habitat is of high interest to salmon managers and marine biologists. While studies continue, surf smelt bulkhead criteria are applied to sandlance spawning sites.

**The 1990's: Marine Beach Front Protective Bulkhead Law**

In 1990, WDF adopted a policy to achieve "no net-loss of productive capacity of the habitat of food fish and shellfish resources of the state" (POL-410, 9/10/90). While it was applied to habitat protection through implementation of the Hydraulic Code, it would not be included in WACs until 1994. By 1990, the five marine habitat biologists rarely used the tidal datum criteria from the 1983 WACs to determine the alignment of the toe of a new bulkhead and nearly all projects were field reviewed. Severe windstorms from the north in winter 1990 and 1991 spurred a large increase in bulkhead repair and construction, lasting several years. Most bulkheads were built as close to the bank as possible in an attempt to apply the no net-loss policy and this initiated many on-site discussions between biologists, planners, contractors and landowner consultants. Still, many bulkheads were built ten feet waterward of the OHWL, particularly on steeply sloped banks.

The Marine Beach Front Protective Bulkhead law, RCW 75.20.160, was passed by Legislature in 1991. The new law restricted construction of bulkheads associated with single-family residences to no more than six feet waterward of the ordinary high water line. In addition, the law requires that bulkhead construction "shall not result in the permanent loss of critical food fish or shellfish habitat". However, the law also restricts the ability of WDF to deny an application for SFR bulkhead construction by stating that the department "shall issue" a HPA. Contractors typically contended that the alignment must extend six feet out to meet "geological, engineering or safety concerns", as allowed by the RCW. WDF staff biologists were often not successful when challenging the alignment due to "geological, engineering or safety concerns" as contractors and consultants were considered more expert on these topics than fish biologists. As a result, most new SFR bulkheads were built waterward to the maximum allowed. In addition, the new RCW did not limit the law to properties with existing structures. Vacant properties suitable for development of a residence could not be denied a bulkhead in accordance with the new law.

The SFR law also required that repairs follow the same alignment as existing unless removal of old structure "…would result in environmental degradation or removal problems related to geological, engineering, or safety considerations". These repairs could "…be placed waterward of and directly abutting the existing structure". Again, most repairs were ultimately placed waterward of existing structures.

In November 1994, the newly merged Department of Fish and Wildlife substantially revised the Hydraulic Code rules, WAC 220-110, to include rules for Single Family Residence bulkheads and to identify "saltwater habitats of special concern". These areas included forage fish spawning areas (Pacific herring, surf smelt, Pacific sandlance and rock sole), juvenile salmonid migration corridors, marine vegetation (eelgrass and macroalgae), juvenile rockfish and lingcod nursery areas. That same year, WDFW biologist Dan Penttila developed a new protocol to systematically sample large areas of beach with bulk sampling techniques, extending the known surf smelt beaches from 68 to 154 miles, and the known sandlance beaches from 5 to 84 miles (Penttila 1995a, Penttila 1995b). The WACs for bulkhead construction also required placement of appropriately sized gravel in front of newly constructed bulkheads for construction related impacts.

The new WACs also included a protocol for mitigation sequencing and incorporated the 1990 policy indicating that "…projects shall incorporate mitigation measures as necessary to achieve no net-loss of productive capacity of fish and shellfish habitat".

**1999: Puget Sound Chinook, Hood Canal summer chum and bull trout listed**

For about five years leading up to the 1999 listing of local salmon stocks under the Endangered Species Act (ESA), residential bulkhead applications spiked as shoreline homeowners anticipated potential listing. Some, but not all, bulkhead contractors actively marketed building bulkheads before potential changes in regulations. The uncertainty prompted many homeowners to build bulkheads out of fear rather than necessity and contractors had long waiting lists. Some local jurisdictions added requirements to demonstrate the need for a bulkhead through a geotechnical analysis and an analysis of alternative options to address the protection needs. However, beach erosion at some level was often taking place and experts debated the causes of erosion and if the rate of erosion was excessive or within the expected range. Local staff and state biologists were again hampered by inability to challenge the geotechnical analysis in an expert capacity and few bulkhead applications were denied shoreline armoring. Geotechnical and engineering analyses often argued that softbank protection techniques (using logs, beach material and vegetation) were largely unproven and that the risk outweighed the benefits. Most structures built during this time period were granted permits for shoreline armoring, but incorporation of some softbank protection techniques was common.

The listing of Puget Sound Chinook (*Oncorhynchus tshawytscha)*, Hood Canal summer chum (*Oncorhynchus keta)* and bull trout *(Salvelinus confluentus)* in 1999 did not change state or local regulatory authority regarding marine shoreline armoring. However, the federal regulations were handled differently than pre-listing. General Condition 11 of the nationwide permits "requires that if endangered or threatened species may occur in the project area, the applicant must notify the Corps prior to construction and ensure that they are in compliance with the ESA." As a result, bulkhead and pier project proponents often had to prepare a biological assessment and be reviewed by National Marine Fisheries Service and/or US Fish and Wildife Service for a Section 7 consultation.

The new procedure resulted in a backlog for federal permit review, with some permits delayed for over a year. Many applicants look to move bulkhead alignment landward of the jurisdictional limit of Corps permits (i.e. MHHW for new structures, or landward of existing structure for repairs) and avoid the requirement to obtain an individual 404 permit. Most bulkhead projects ultimately were built far landward of pre-listing projects. Over the last decade, much effort was devoted to shoreline landowner stewardship workshops, outreach and technical assistance to promote alternatives to bulkheads, where appropriate. Encouraged by federal staff, WDFW field staff and many local jurisdictions, softbank protection and inclusion of woody debris became more common in shoreline development proposals to make them more "fish-friendly".

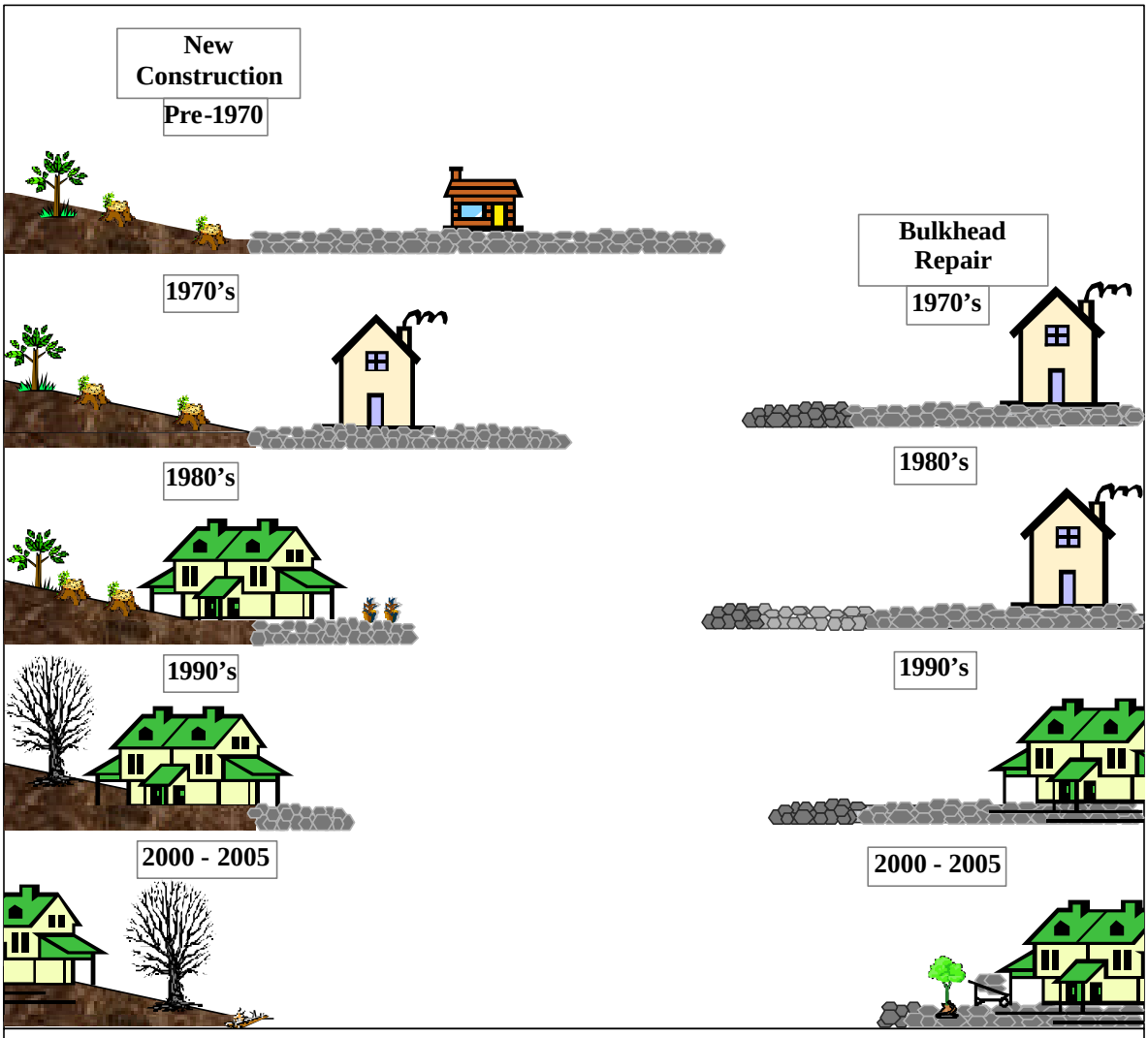



Figure 3; Summary of Puget Sound shoreline armoring over time since 1970.

Providing technical assistance to landowners and local jurisdictions was a high priority for state agencies in the new millennium. The State Legislature regularly reviews the Hydraulic Code and annually proposes changes, primarily to limit WDFW regulatory authority for habitat protection. In 2001, WDFW along with Washington Department of Transportation and Washington Department of Ecology funded completion of a series of white papers proposing guidelines for aquatic habitat protection. The white paper, "Marine and Estuarine Shoreline Modification Issues" (Williams and Thom 2001), reviewed the best available science and recommended fish-friendly designs and alternatives. In particular, the paper stressed the need to address marine shoreline armoring cumulative impacts, rather than the project by project review imposed by the Hydraulic Code. When the state

convened a HPA task force in 2002, the task force also set as a priority issue to develop a mechanism to address cumulative impacts.

This year, WDFW started planning for revision of the Hydraulic Code rules with proposed completion by 2007. At this time, the Hydraulic Code, recently recodified as RCW 77.55, has 37 sections compared with the original 1949 version of a single paragraph. Most of the revisions before 1985 sought to clarify the broad authority of WDF and WDG to protect fish life, while most of the revisions after 1985 restricted the authority or established special procedures for certain types of projects. Our increased understanding of nearshore ecosystem principles and processes suggest using a precautionary approach in protecting shoreline habitat for fish resources.

## Conclusions

Since the Hydraulic Code was enacted in 1949 there has been considerable progress within the Code for protecting marine shorelines and in particular in addressing shoreline armoring. From the initial application of the Code to marine waters in 1977 until present many changes have been included to reduce impacts from armoring on marine shorelines, mostly by reducing the waterward extent of encroachment onto the beach from new construction and repairs. However, in 1991, the Legislature made it clear they wanted to ensure timely issuance of HPAs for single-family residential bulkheads through enactment of the single-family residence bulkhead law (RCW 77.55.200). Although this statute contained language that required bulkhead placement closer to OHWL, it also made the prospect of denying an application for a bulkhead particularly difficult. In large part, the Code has not served as an effective regulatory tool in preventing unnecessary bulkhead construction, as it does not address the need for shoreline armoring, even on vacant parcels. Basically, current regulations authorize the permanent, unmitigated loss of shoreline habitat through allowing up to six feet of encroachment onto the beach for new bulkhead construction. And, the current regulations fall far short of protecting shoreline processes and functions by allowing continued armoring of important sediment sources.

It is important to clearly understand the measure of protection of fish life involved in issuance of a HPA. Many local, state and federal agency permits heavily rely on WDFW staff for technical input for protection of fish and wildlife resources. This is appropriate in an overall sense. However, using the issuance of a HPA as the standard for determining that fish and wildlife needs are met is mistaken. The HPA fails to address key fish and wildlife habitat concerns that often should be addressed in other planning efforts, rather than through WDFW regulatory authority. In summary, issuance of a HPA for marine shoreline armoring does NOT necessarily mean:

- The proposed project is necessary and is the least impacting alternative available
- Cumulative impacts to fish habitat are avoided or mitigated
- No net-loss of fish habitat is achieved
- Wildlife habitat protection needs are met
- Impacts to natural physical and biological beach processes are avoided or mitigated
- Impacts to fish habitat that occur landward of the OHWL are avoided or mitigated

One of the most challenging issues involving protection of shoreline fish habitat is the cumulative impact of shoreline alterations. The HPA permit process functions largely in a reactive mode, seeking to mitigate project impacts on each project separately. This approach makes it difficult to address important shoreline processes (e.g., lost sediment supply) that support habitat formation and maintenance. Comprehensive approaches, including land-use planning that avoids the need for shoreline armoring, would better protect shoreline functions and habitats. Conducting a comprehensive assessment of existing shoreline conditions can provide a basis for this planning effort. Those portions of the shoreline that are unarmored should be subject to additional analysis to better understand the potential impacts (including direct, indirect, and cumulative) of any proposed shoreline armoring. And, efforts should be made to protect and conserve areas determined to be important to shoreline processes (e.g., sediment supply) and biological functions (e.g., spawning areas and migratory corridors).

Habitat benefits may be increased by inclusion of language in the RCW that discourages bank armoring and encourages retention of shoreline vegetation and large woody debris. If bank armoring is necessary, evaluation

of alternative softbank techniques that utilize beach nourishment, bioengineering, and other vegetation techniques should be required. To reduce impacts from existing structures, many built without permits, compliance with current regulations should be required for replacement structures. This could recover lost beach habitat in many locations as well as reduce impacts to longshore transport processes. However, adding these statements to the Code does not guarantee change in implementation and improvement in resource protection. Biologists and planners will still face the task of challenging consultant reports when interpretation of expert analyses is involved. Therefore, the regulation itself may not be the bottleneck in habitat protection. Societal acceptance of alternate approaches to shoreline residences and protection techniques by shoreline landowner education and incentive programs may provide better results.

Ideally, the Hydraulic Code would allow WDFW permit reviewers to err on the side of caution when making decisions on bulkhead applications. This would promote conservation of natural ecological functions. Unfortunately, the necessary public and legislative support seems lacking and appears to favor those who wish to construct bulkheads, regardless of need. The 1991 SFR bulkhead law (RCW 77.55.200) and the Shoreline Substantial Development Permit exemption both diminish the importance of shoreline functions in the regulatory process and favor issuance of permits for bulkhead construction. This lack of authority prevents adequate protection of shoreline processes and habitats. In addition to targeted research on shoreline processes and functions to support habitat protection, a concerted effort must be made to educate shoreline owners, legislators, and the general public on the importance of shoreline processes and habitats. Finally, a single-agency approach will not adequately address the problems; a cooperative effort by several agencies, local government, tribes, organizations, and individuals is needed to succeed.

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**List of Acronyms**

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| ESA | Endangered Species Act |
| HPA | Hydraulic Project Approval |
| MHHW | Mean Higher High Water |
| NWP | Nationwide Permit (federal) |
| OHWL | Ordinary High Water Line |
| RCW | Revised Code of Washington |
| SFR | Single Family Residence |
| SMA | Shoreline Management Act |
| WAC | Washington Administrative Code |
| WDFW | Washington Department of Fish and Wildlife (formerly WDF & WDW) |
| WDF | Washington Department of Fisheries |
| WDG | Washington Department of Game |
| WDW | Washington Department of Wildlife (formerly Game) |